

Application No: 10/810,080 Docket No.: Q202-US1

Page 2

IN THE CLAIMS**RECEIVED
CENTRAL FAX CENTER**

OCT 22 2008

Please amend the claims as follows:

1. (currently amended) An electrochemical device, comprising:
 an electrolyte including one or more polysiloxanes, one or more alkali metal salts, and one or more silanes,
 the silane and the polysiloxane being included in different compounds, and
 the silane including at least one substituent that includes a poly(alkylene oxide)
 moiety.
2. (withdrawn) The device of claim 1, wherein at least one polysiloxane is cyclic.
3. (previously presented) The device of claim 1, wherein at least one polysiloxane has a backbone that includes one or more silicons linked to one or more side chains that include a poly(alkylene oxide) moiety.
4. (previously presented) The device of claim 3 wherein the backbone includes one or more silicons linked to one or more side chains that include a carbonate moiety.
5. (withdrawn) The device of claim 3, wherein one or more of the backbone silicons are linked to a plurality of side chains that each include a poly(alkylene oxide) moiety.
6. (withdrawn) The device of claim 3, wherein an organic spacer is positioned between the backbone silicons and the poly(alkylene oxide) moiety.
7. (withdrawn) The device of claim 6, wherein the spacer includes oxygen linked directly to the backbone silicons.
8. (currently amended) The device of claim 1, whercin the silane includes ~~at least one substituent that includes a moiety selected from a first group consisting of an alkyl group, an aryl group, an alkoxy group, an alkylene oxide group or a poly(alkylene oxide) and at~~

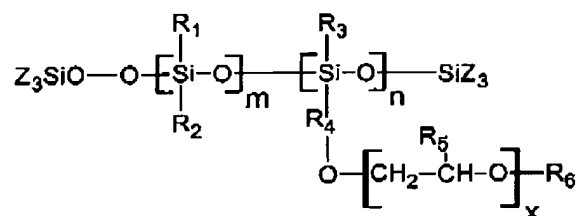
Application No: 10/810,080 Docket No.: Q202-US1

Page 3

least one substituent that includes a moiety selected from a second group consisting of an alkoxy group, a carbonate group, and an alkylene oxide group and a ~~poly(alkylene oxide)~~ group.

9. (canceled)

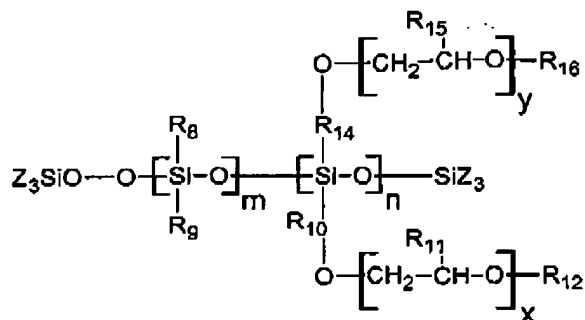
10. (previously presented) The device of claim 1, wherein at least one polysiloxane has a structure selected from a group consisting of structures represented by formula I-a through formula I-d:



formula I-a:

where R₁ is an alkyl

group, R₂ is an alkyl group or an alkoxy group, R₃ is an alkyl group, R₄ is nil or an organic spacer, R₅ is a hydrogen atom or an alkyl group, and R₆ are alkyl groups, Z is an alkyl or an aryl group, m is from 0 to 15, n is from 1 to 30, x is from 2 to 15;



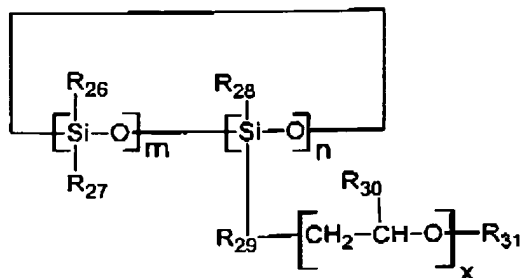
formula I-b:

wherein R₈ is an alkyl

group, R₉ is an alkyl group or an alkoxy group, R₁₀ is nil or an organic spacer, R₁₁ is a hydrogen or an alkyl group, R₁₂ is an alkyl group, R₁₄ is nil or an organic spacer, R₁₅ is a hydrogen or an alkyl group, R₁₆ is an alkyl group, Z is an alkyl or an aryl group, m is from 0 to 15, n is from 1 to 30, x is from 2 to 15; and

Application No: 10/810,080 Docket No.: Q202-US1

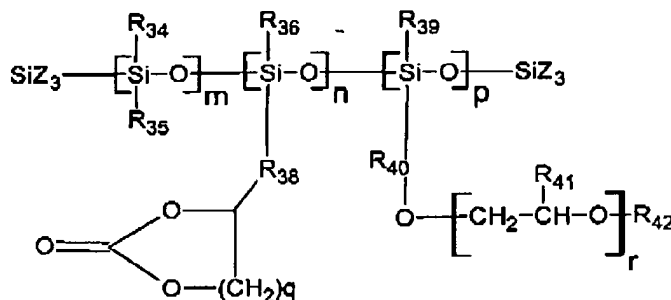
Page 4



formula I-c:

wherein, R_{26} is an alkyl

group, R_{27} is an alkyl group or an alkoxy group, R_{28} is an alkyl group, R_{29} is an oxygen or an organic spacer, R_{30} is a hydrogen atom or an alkyl group, R_{31} is alkyl group, m is 0 or greater than 0, n is from 3 to 10, and x is from 2 to 15; and



formula I-d:

where, R_{34} is

an alkyl group; R_{35} is an alkyl group or an alkoxy group; R_{36} is an alkyl group; R_{38} is nil or an oxygen or an organic spacer; R_{39} is an alkyl group; R_{40} is an organic spacer; R_{41} is a hydrogen or an alkyl group; R_{42} is an alkyl group; Z is an alkyl or an aryl group; m is 0 or greater than 0; n is 1 to 30; p is greater than 0; q is 1 or 2; r is 2 to 15.

11. (previously presented) The device of claim 10, wherein m is 0.

12. (withdrawn) The device of claim 10, wherein R_4 , R_{10} , R_{14} , R_{29} , R_{38} and R_{40} , are nil.

13. (previously presented) The device of claim 10, wherein R_4 , R_{10} , R_{14} , R_{29} , and R_{38} are an organic spacer.

14. (currently amended) The device of claim 10 wherein the polysiloxane is represented by formula I-d and the organic spacer represented by R_{40} includes an oxygen linked directly to a silicon on the backbone of the polysiloxane.

Application No: 10/810,080 Docket No.: Q202-US1

Page 5

15. (withdrawn) The device of claim 10, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-a.

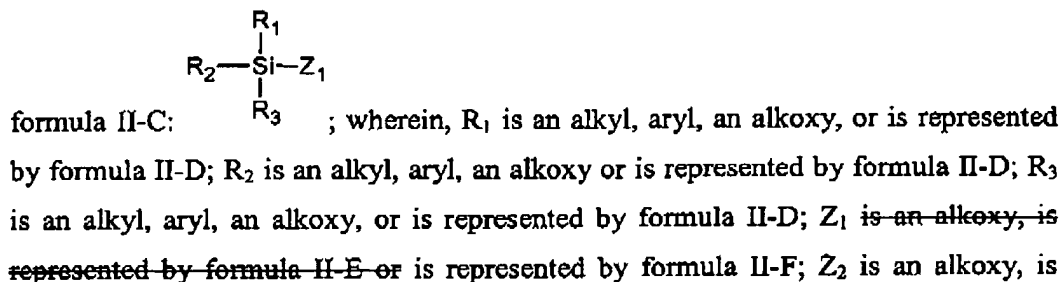
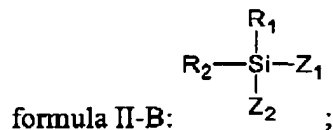
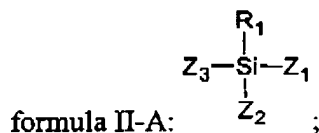
16. (withdrawn) The device of claim 10, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-b.

17. (withdrawn) The device of claim 10, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-c.

18. (previously presented) The device of claim 10, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-d.

19. (withdrawn) The device of claim 18, wherein p is 0.

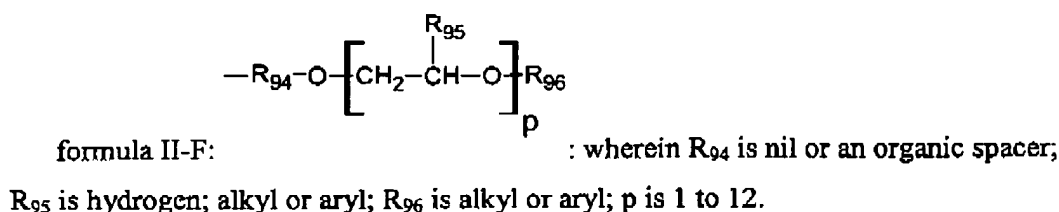
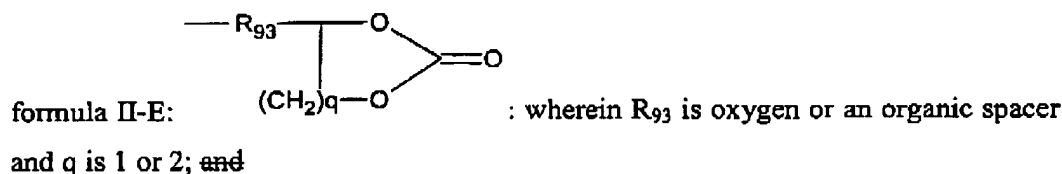
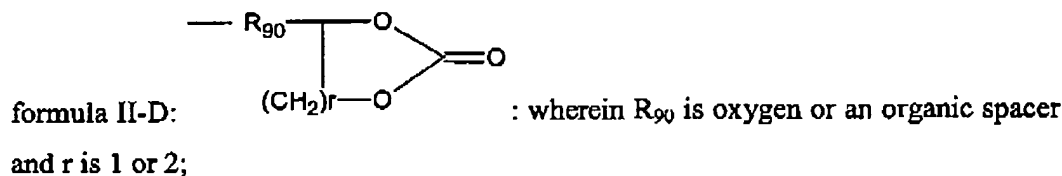
20. (currently amended) The device of claim 1, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-a through formula II-c;



Application No: 10/810,080 Docket No.: Q202-US1

Page 6

represented by formula II-E or is represented by formula II-F; Z₃ is an alkoxy, is represented by formula II-E or is represented by formula II-F;



21. (previously presented) The device of claim 20, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-a.

22. (withdrawn) The device of claim 20, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-b.

23. (withdrawn) The device of claim 20, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-c.

24. (previously presented) The device of claim 20, wherein at least one of the R₁, R₂, R₃, Z₁, Z₂, and Z₃ includes an organic spacer, the organic spacer being an alkylene, alkylene oxide or a bivalent ether group.

25. (previously presented) The device of claim 20, wherein at least one of the R₁, R₂, R₃ includes a halogenated alkyl, a halogenated aryl or a halogenated alkoxy.

Application No: 10/810,080 Docket No.: Q202-US1

Page 7

26. (previously presented) The device of claim 1, wherein the salt is a lithium salt.
27. (previously presented) The device of claim 1, wherein the concentration of alkali metal salt is about 0.3 to 2.0 M.
28. (previously presented) The device of claim 1, wherein the salt is chosen from the group consisting of: LiClO_4 , LiBF_4 , LiAsF_6 , LiPF_6 , LiCF_3SO_3 , $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{Li}(\text{CF}_3\text{SO}_2)_3\text{C}$, $\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$, lithium alkyl fluorophosphates, lithium bis(chelato)borates, and mixtures thereof.
29. (previously presented) The device of claim 1, wherein the electrolyte further includes:
at least one additive selected from the group consisting of: vinyl carbonate, vinyl ethylene carbonate, ethylene sulfite, 1,3 dimethyl butadiene, styrene carbonate, aromatic carbonates, vinyl pyrrole, vinyl piperazine, vinyl piperidine, vinyl pyridine, and mixtures thereof.
30. (previously presented) The device of claim 1, wherein the electrolyte includes a lithium(oxalato)borate (LiBOB) salt and one or more additives selected from a group consisting of VC and VEC.
31. (previously presented) The device of claim 1, wherein the device is lithium secondary battery comprising:
a lithium metal oxide cathode;
a porous separator; and
a carbon or lithium metal anode.
32. (previously presented) The device of claim 31, wherein the cathode includes a material chosen from the group consisting of: Li_xVO_y , LiCoO_2 , LiNiO_2 , $\text{LiNi}_{1-x}\text{Co}_x\text{Me}_2\text{O}_2$, $\text{LiMn}_{0.5}\text{Ni}_{0.5}\text{O}_2$, $\text{LiMn}_{0.3}\text{Co}_{0.3}\text{Ni}_{0.3}\text{O}_2$, LiFePO_4 , LiMn_2O_4 , LiFeO_2 ,

Application No: 10/810,080 Docket No.: Q202-US1

Page 8

$\text{LiMc}_{0.5}\text{Mn}_{1.5}\text{O}_4$, vanadium oxide, and mixtures thereof, wherein Me is Al, Mg, Ti, B, Ga, or Si, and Mc is a divalent metal.

33. (previously presented) The device of claim 31, wherein the anode includes a material chosen from the group consisting of: graphite, carbon, $\text{Li}_4\text{Ti}_5\text{O}_{12}$, tin alloys, silica alloys, intermetallic compounds, lithium metal, and mixtures thereof.

34. (previously presented) The device of claim 1, wherein the electrolyte is a liquid.

35. (withdrawn) The device of claim 1, wherein the electrolyte is a solid.

36. (currently amended) The device of ~~claim 35~~ claim 1, wherein the electrolyte includes an interpenetrating network.

37. (previously presented) The device of claim 36, wherein the interpenetrating network includes a cross-linked polyacrylates or a cross-linked polymethacrylates.

38. (previously presented) The device of claim 36, wherein a compound selected from the group consisting of an acrylate having two or more functionalities and a methacrylates having two or more functionalities serves as a monomer for a member of the interpenetrating network.

39. (previously presented) The device of claim 38, wherein the monomer is a dialkyl acrylate, dimethacrylate, a diallyl terminated compound or a dialkyl methacrylate.

40. (previously presented) The device of claim 38, wherein the electrolyte includes one or more solid polymers.

41. (previously presented) The device of claim 40, wherein at least one of the solid polymers is selected from the group consisting of polyacrylonitrile (PAN), poly(methyl methacrylate) (PMMA), poly(vinylidene fluoride) (PVDF), poly(vinylidene fluoride-co-

Application No: 10/810,080 Docket No.: Q202-US1

Page 9

hexafluoropropylene), polystyrene, polyvinyl chloride, poly(alkyl methacrylate), poly(alkyl acrylate), styrene butadiene rubber (SBR), poly(vinyl acetate), poly(ethylene oxide) (PEO) and mixtures thereof.

42. (previously presented) The device of claim 1, wherein the electrolyte has an ionic conductivity greater than 1.0×10^{-4} S/cm at 25 °C.

43. (previously presented) The device of claim 1, wherein the electrolyte has an ionic conductivity greater than 4.0×10^{-4} S/cm at 25 °C.

44. (withdrawn) A method of forming an electrochemical device, comprising:
forming an electrolyte including one or more polysiloxanes, one or more alkali metal salts, and one or more silanes,

the silane and the polysiloxane being included in different compounds,

and

the silane including at least one substituent that includes a poly(alkylene oxide) moiety; and

activating at least one anode and at least one cathode with the electrolyte.

45. (withdrawn) The method of claim 44, wherein at least one polysiloxane is cyclic.

46. (withdrawn) The method of claim 44, wherein at least one polysiloxane has a backbone that includes one or more silicons linked to one or more side chains that include a poly(alkylene oxide) moiety.

47. (withdrawn) The method of claim 46, wherein one or more of the backbone silicons are linked to a plurality of side chains that each include a poly(alkylene oxide) moiety.

48. (withdrawn) The method of claim 46, wherein an organic spacer is positioned between the backbone silicons and the poly(alkylene oxide) moiety.

Application No: 10/810,080 Docket No.: Q202-US1

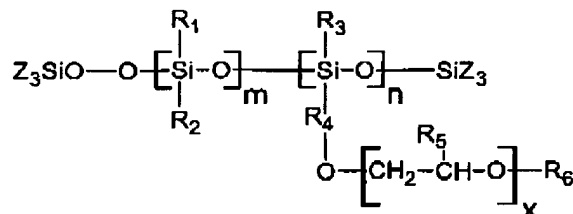
Page 10

49. (withdrawn) The method of claim 46, wherein the spacer includes an oxygen linked to the backbone silicons.

50. (withdrawn) The method of claim 44, wherein the silane includes at least one substituent that includes a moiety selected from a first group consisting of an alkyl group, a halogenated alkyl group, an aryl group, a halogenated aryl group, an alkoxy group and an oxyalkylene group and at least one substituent that includes a moiety selected from a second group consisting of an alkoxy group, an oxyalkylene group or a cyclic carbonate group.

51. (withdrawn) The method of claim 50, wherein the silane includes four substituents that each includes a moiety selected from the first group or from the second group.

52. (withdrawn) The method of claim 44, wherein at least one polysiloxane has a structure selected from a group consisting of structures represented by formula I-a through formula I-d:



formula I-a:

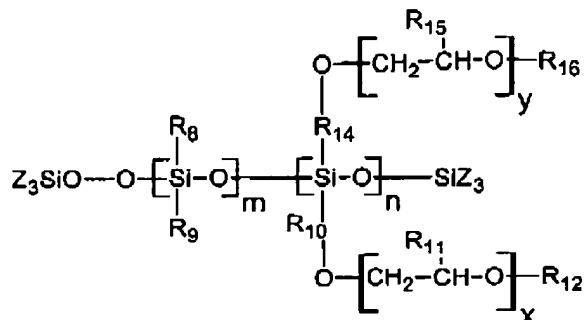
where R₁ is an alkyl

group, R₂ is an alkyl group or an alkoxy group, R₃ is an alkyl group, R₄ is nil or an organic spacer, R₅ is a hydrogen atom or an alkyl group, and R₆ are alkyl groups, Z is an alkyl or an aryl group, m is from 0 to 15, n is from 1 to 30, x is from 2 to 15;

Application No: 10/810,080

Docket No.: Q202-US1

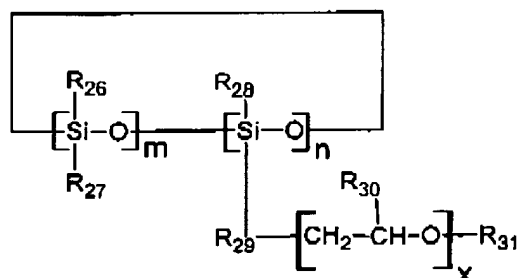
Page 11



formula I-b:

wherein R₈ is an alkyl

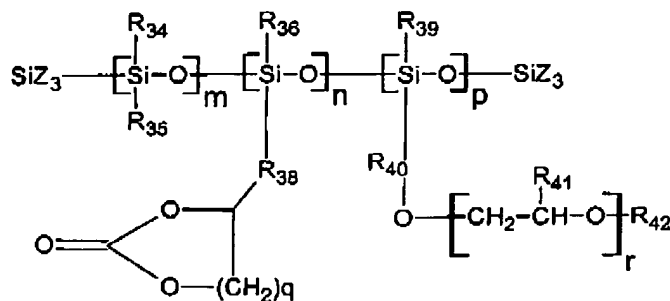
group, R₉ is an alkyl group or an alkoxy group, R₁₀ is nil or an organic spacer, R₁₁ is a hydrogen or an alkyl group, R₁₂ is an alkyl group, R₁₄ is nil or an organic spacer, R₁₅ is a hydrogen or an alkyl group, R₁₆ is an alkyl group, Z is an alkyl or an aryl group, m is from 0 to 15, n is from 1 to 30, x is from 2 to 15; and



formula I-c:

wherein, R₂₆ is an alkyl

group, R₂₇ is an alkyl group or an alkoxy group, R₂₈ is an alkyl group, R₂₉ is an oxygen or an organic spacer, R₃₀ is a hydrogen atom or an alkyl group, R₃₁ is alkyl group, m is 0 or greater than 0, n is from 3 to 10, and x is from 2 to 15; and



formula I-d:

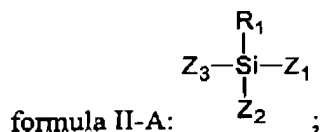
where, R₃₄ is

an alkyl group; R₃₅ is an alkyl group or an alkoxy group; R₃₆ is an alkyl group; R₃₈ is nil or an oxygen or an organic spacer; R₃₉ is an alkyl group; R₄₀ is nil or an organic spacer; R₄₁ is a hydrogen or an alkyl group; R₄₂ is an alkyl group; Z is an alkyl or an aryl group; m is 0 or greater than 0; n is 1 to 30; p is 0 or greater than 0; q is 1 or 2; r is 2 to 15.

Application No: 10/810,080 Docket No.: Q202-US1

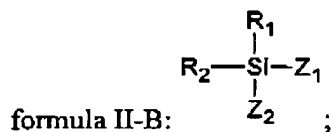
Page 12

53. (withdrawn) The method of claim 52, wherein m is 0.
54. (withdrawn) The method of claim 52, wherein R₄, R₁₀, R₁₄, R₂₉, R₃₈ and R₄₀, are nil.
55. (withdrawn) The method of claim 52, wherein R₄, R₁₀, R₁₄, R₂₉, R₃₈ and R₄₀, are an organic spacer.
56. (withdrawn) The method of claim 55, wherein the organic spacer includes an oxygen linked to a silicon on the backbone of the polysiloxane.
57. (withdrawn) The method of claim 52, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-a.
58. (withdrawn) The method of claim 52, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-b.
59. (withdrawn) The method of claim 52, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-c.
60. (withdrawn) The method of claim 52, wherein at least one polysiloxane has a structure selected from the group consisting of structures represented by formula I-d.
61. (withdrawn) The method of claim 60, wherein p is 0.
62. (withdrawn) The method of claim 44, wherein at least one silane is selected from a group represented by formula II-a through formula II-c:

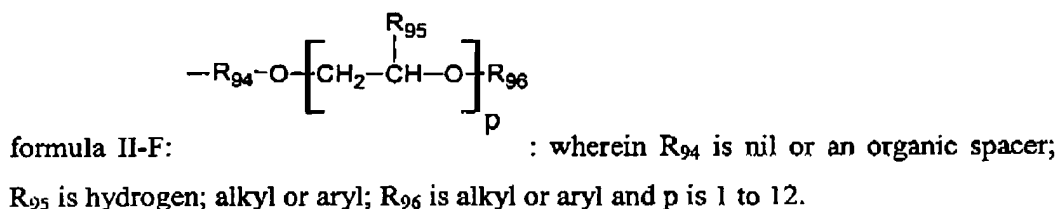
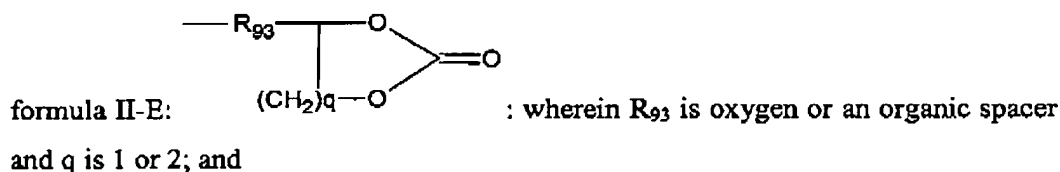
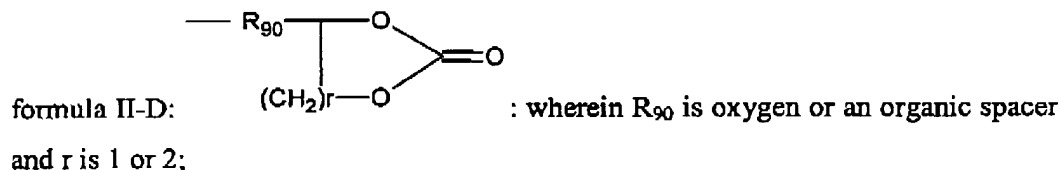


Application No: 10/810,080 Docket No.: Q202-US1

Page 13



formula II-C:
$$\begin{array}{c} R_1 \\ | \\ R_2 - Si - Z_1 \\ | \\ R_3 \end{array} ;$$
 wherein, R_1 is an alkyl, aryl, an alkoxy, or is represented by formula II-D; R_2 is an alkyl, aryl, an alkoxy or is represented by formula II-D; R_3 is an alkyl, aryl, an alkoxy, or is represented by formula II-D; Z_1 is an alkoxy, is represented by formula II-E or is represented by formula II-F; Z_2 is an alkoxy, is represented by formula II-E or is represented by formula II-F; Z_3 is an alkoxy, is represented by formula II-E or is represented by formula II-F;



63. (withdrawn) The method of claim 62, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-a.

64. (withdrawn) The method of claim 62, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-b.

Application No: 10/810,080 Docket No.: Q202-US1

Page 14

65. (withdrawn) The method of claim 62, wherein at least one silane has a structure selected from a group consisting of structures represented by formula II-c.

66. (withdrawn) The method of claim 44, wherein the electrolyte includes at least one additive selected from the group consisting of: vinyl carbonate, vinyl ethylene carbonate, ethylene sulfite, 1,3 dimethyl butadiene, styrene carbonate, aromatic carbonates, vinyl pyrrole, vinyl piperazine, vinyl piperidine, vinyl pyridine, and mixtures thereof.

67. (withdrawn) The method of claim 44, wherein at least one cathode is a lithium metal oxide cathode and at least one anode is a carbon or lithium metal anode.

68. (withdrawn) The method of claim 44, wherein at least one cathode includes a material chosen from the group consisting of: LiCoO_2 , LiNiO_2 , $\text{LiNi}_{1-x}\text{Co}_x\text{Me}_2\text{O}_2$, $\text{LiMn}_{0.5}\text{Ni}_{0.5}\text{O}_2$, $\text{LiMn}_{0.3}\text{Co}_{0.3}\text{Ni}_{0.3}\text{O}_2$, LiFePO_4 , LiMn_2O_4 , LiFeO_2 , $\text{LiMn}_{0.5}\text{Mn}_{1.5}\text{O}_4$, vanadium oxide, and mixtures thereof, wherein Me is Al, Mg, Ti, B, Ga, or Si, and Mc is a divalent metal.

69. (withdrawn) The method of claim 44, wherein at least one anode includes a material chosen from the group consisting of: graphite, carbon, $\text{Li}_4\text{Ti}_5\text{O}_{12}$, tin alloys, silica alloys, intermetallic compounds, lithium metal, and mixtures thereof.

70. (withdrawn) The method of claim 44, wherein the electrolyte is a liquid.

71. (withdrawn) The method of claim 44, wherein the electrolyte is a solid.

72. (withdrawn) The method of claim 44, wherein forming the electrolyte includes forming an interpenetrating network.

73. (previously presented) The device of claim 18, wherein m is 0;

R_{38} is an organic spacer; and

the organic spacer represented by R_{40} includes an oxygen linked directly to a

Application No: 10/810,080 Docket No.: Q202-US1

Page 15

silicon on the backbone of the polysiloxane.

74. (new) The device of claim 21, wherein the variable R_{94} in the substituent represented by Z_1 is nil.